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FRED BURR RESERVOIR DAM

MANUAL FOR OPERATION AND MAINTENANCE

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State Water Projects Bureau
Water Resources Division
Department of Natural Resources and Conservation
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P.O. Box 201601
Helena, MT 59620-1601

Initial Publication May 2001

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TABLE OF CONTENTS

	Page
OVERVIEW	1
Fred Burr Reservoir Location Map (Figure 1)	3
Fred Burr Project Map (Figure 2)	4
Fred Burr Dam General Layout (Figure 3)	5
Fred Burr Reservoir Topographic Map (Figure 4)	6
STATISTICAL INFORMATION	7
OPERATING PROCEDURES	11
Method and Schedule of Operation	11
Safe Drawdown	12
Limits of Appurtenances	12
Dam Operator	12
Weather Monitoring	14
Interaction with Other Dams	14
Emergency	14
INSPECTION AND MONITORING	15
Structural Features Inspection	15
Riprap Inspection	16
Seepage Monitoring	16
MAINTENANCE	17
Routine Maintenance	17
Annual Maintenance	18
Record Keeping	19
REFERENCES	21
APPENDICES	23
A. RATING CURVES AND TABLES	A1
Table 1. ACTIVE STORAGE TABLE	A2
Table 2. SPILLWAY RATING CURVE AND TABLE	A3
B. INSPECTION REPORT FORM	B1
C. DISTRIBUTION LIST	C1
D. PROJECT DRAWINGS	D1

OVERVIEW

Fred Burr Reservoir dam and reservoir are located on public land in the Bitterroot National Forest administered by the U.S. Forest Service. The project is operated under a U.S. Forest Service special-use permit. Fred Burr reservoir is located near the headwaters of Fred Burr Creek, a tributary of the Bitterroot River in Ravalli County, approximately 9 miles southwest of Victor and 10 miles northwest of Hamiltion, Montana (see Figures 1 and 2). Figure 3 provides a general layout of the dam, spillway and outlet works. Figure 4 is a topographic map of the reservoir and surrounding area.

The dam is owned by the Montana Department of Natural Resources (DNRC) and is managed by the State Water Projects Bureau (SWPB) of the DNRC. The Fred Burr Water Users Association (herein called the "association") operates and maintains the dam.

The earthfill dam was completed in 1948. The dam is 50 feet high and 325 feet long. The reservoir stores 410 acre-feet at the spillway crest and 525 acre-feet at the top of the spillway gate.

The dam's outlet works, located near the middle of the dam, consists of a four-foot diameter conduit, a single cell wet tower, and a manually operated 48-inch diameter slide gate. The control mechanism is located at the top of the gate tower on the dam crest.

The spillway, located in the right abutment, is a 20-foot wide concrete-lined rectangular chute controlled with a 4.3-foot-high radial gate. The maximum capacity of the spillway is 1,900 cfs

with the reservoir pool at the dam crest with the radial gate open, and 850 cfs with the gate closed.

Water from the reservoir is primarily used for agricultural irrigation. The reservoir is also used for water-based recreation and the regulation of stream flow rates.

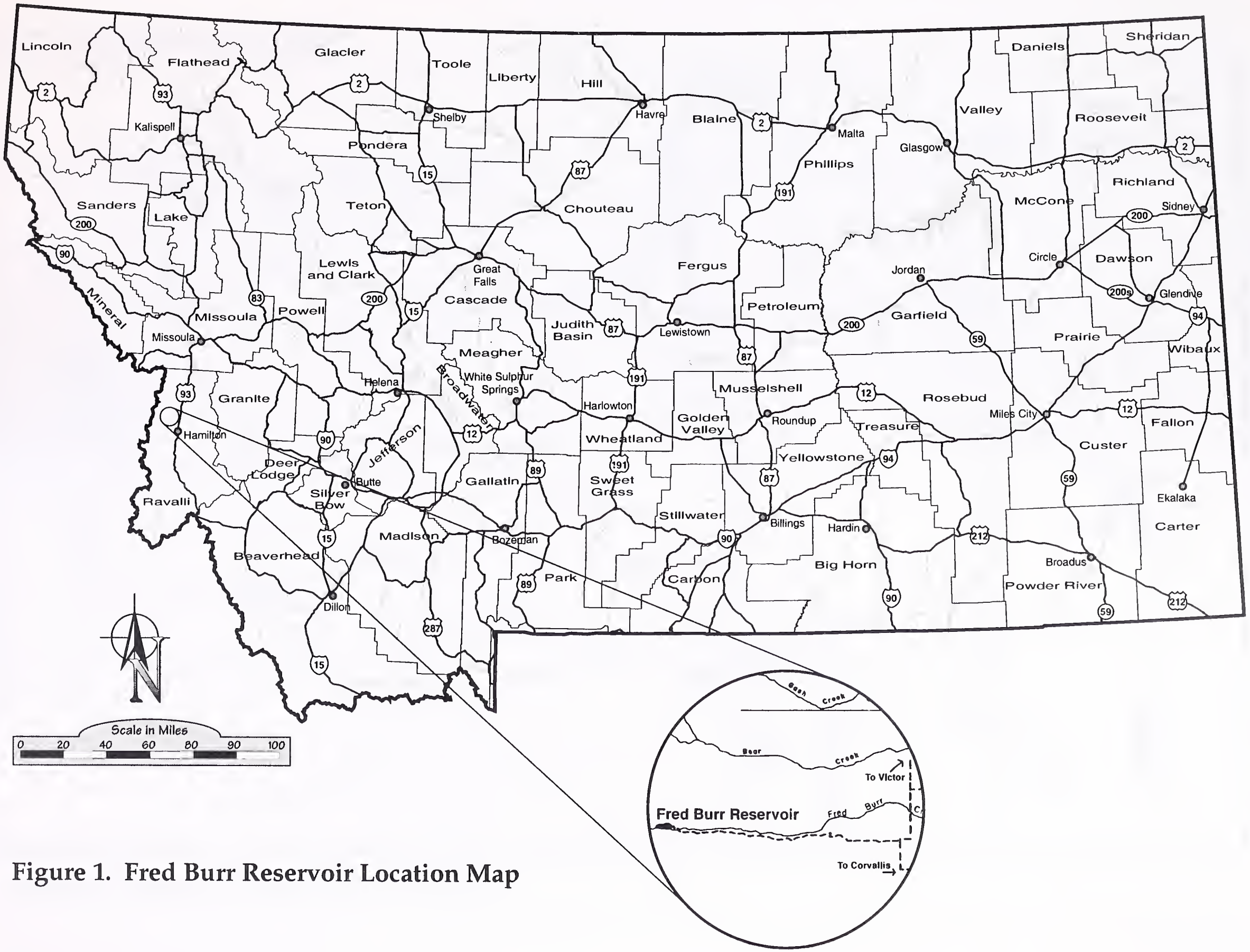


Figure 1. Fred Burr Reservoir Location Map

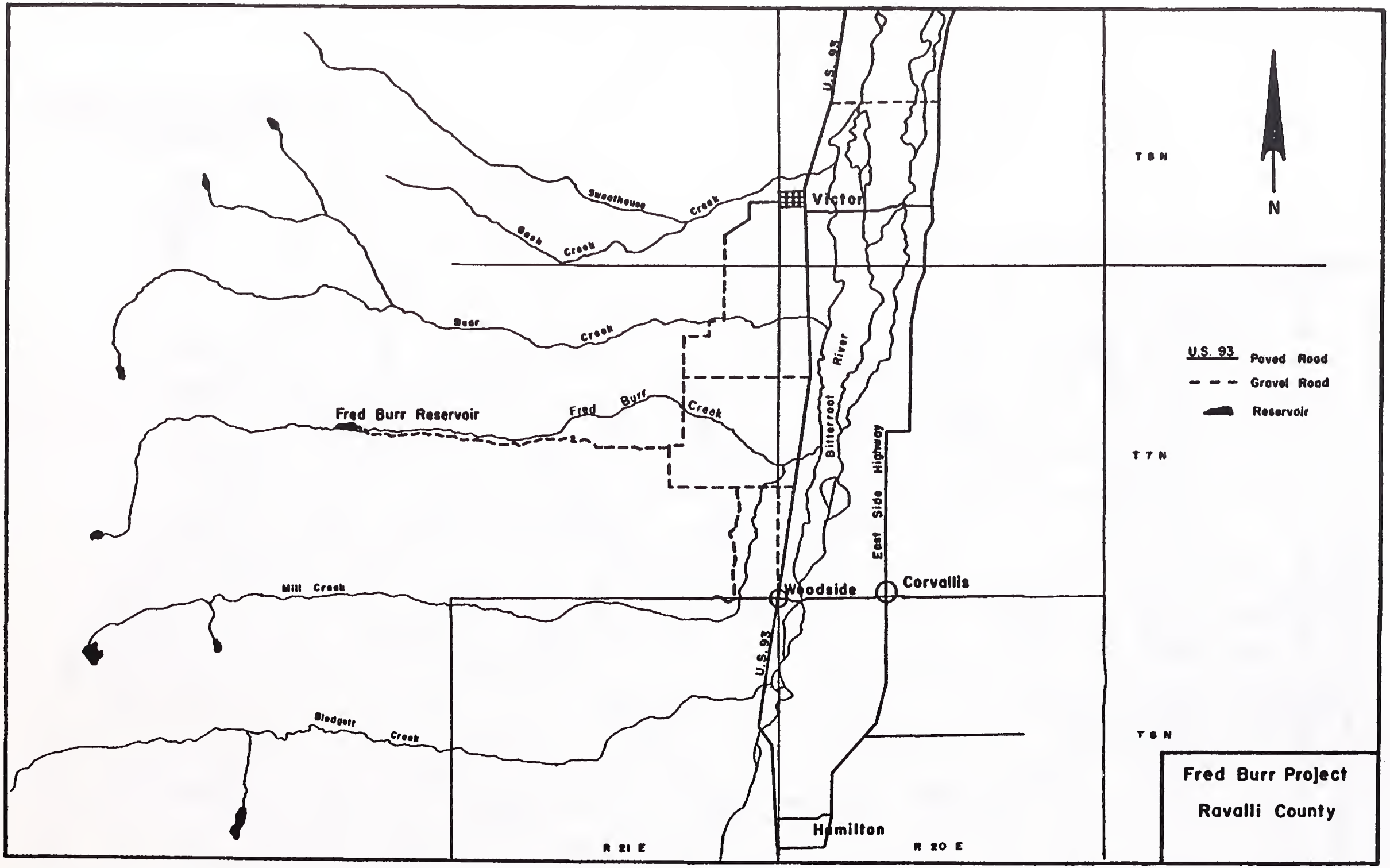


Figure 2. Fred Burr Project Map

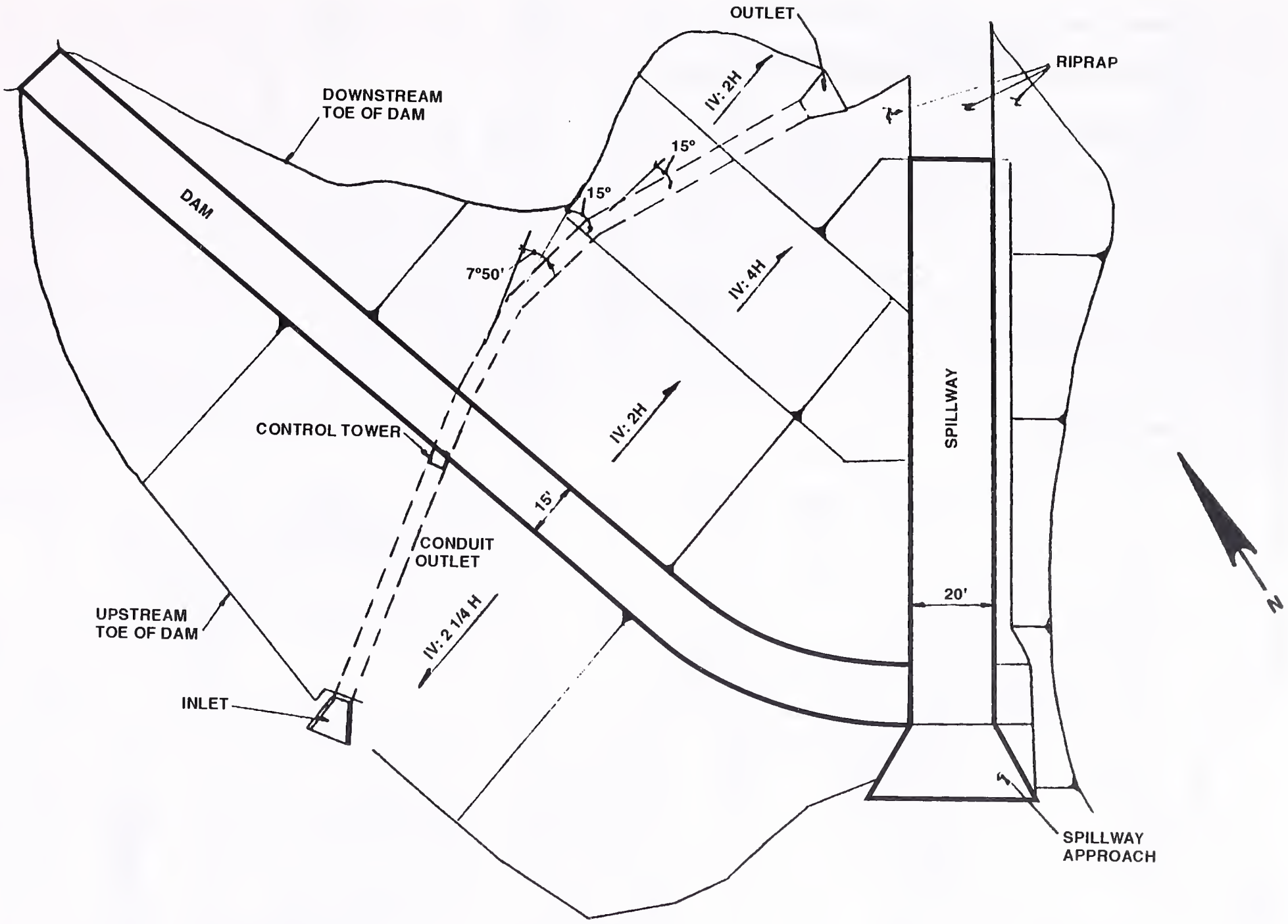


Figure 3. Fred Burr Dam General Layout

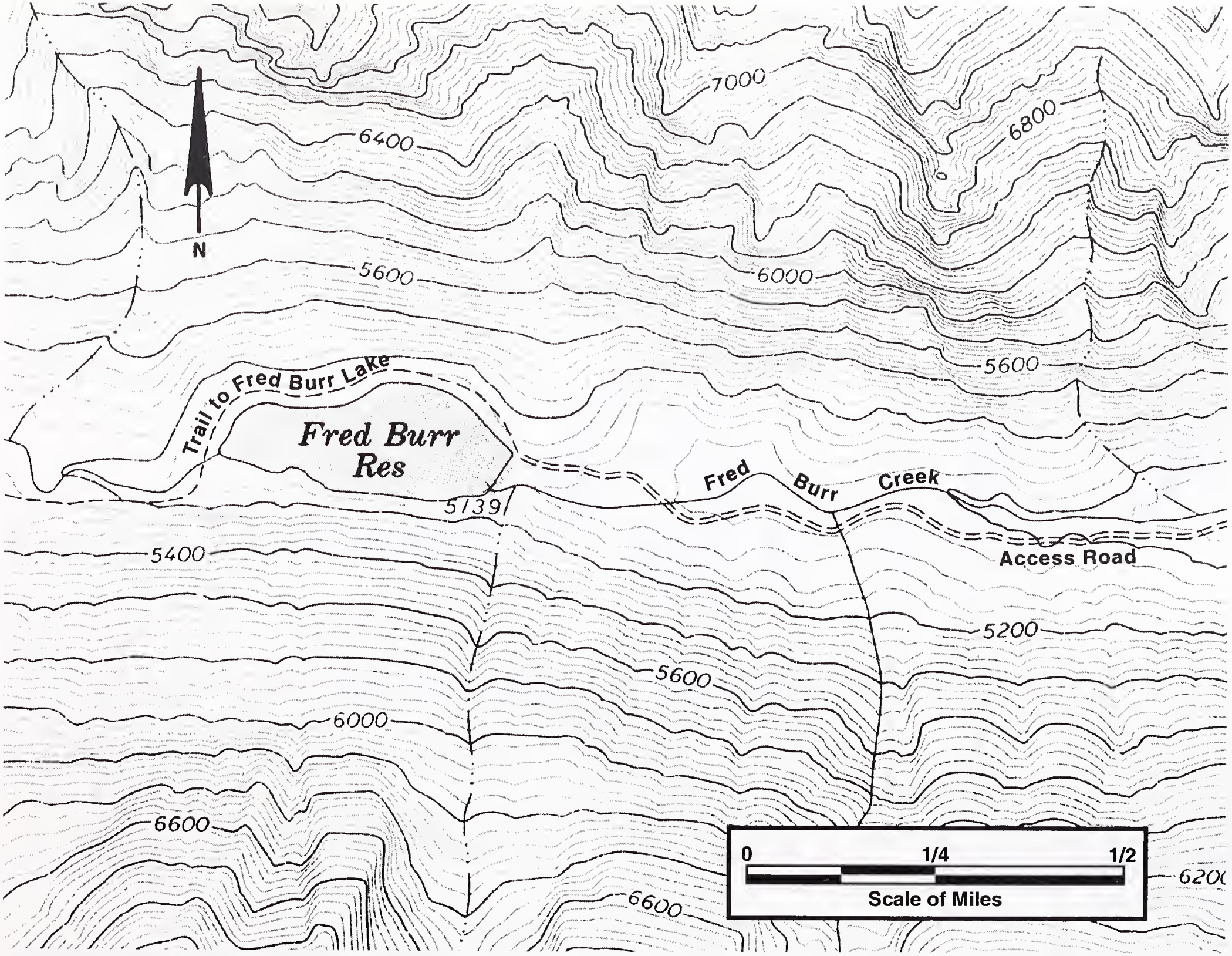


Figure 4. Fred Burr Reservoir Topograhic Map

STATISTICAL INFORMATION

1. General

a. Owner	State Montana Department of Natural Resources and Conservation (DNRC).
b. Operator	Fred Burr Water Users Association.
c. Location	Section 14 Township 7 North, Range 22 West Ravalli County Montana Principal Meridian
d. Latitude Longitude	46.356° 114.32°
e. County -- State	Ravalli County, Montana
f. Watershed Location	Fred Burr Creek.
g. USGS Quadrangle	Printz Ridge

2. Principle Elevations (feet above mean sea level)

a. Minimum Dam Crest	5148.8 feet
b. Top of Radial Gate	5143.3 feet
c. Normal Full Pool (at spillway crest)	5139.0 feet
d. Spillway Crest	5139.0 feet
e. Outlet Works	
Inlet Invert	5112 (estimated)
Outlet Invert	5098 (estimated)

3. Reservoir

a. Surface Area (at normal full pool)	28 acres
b. Drainage Area	11.8 square miles
c. Length of Maximum Pool	¾ miles (approximate)

4. Storage

a. Maximum Storage (at dam crest)	690 acre-feet
b. Active Storage (at top of radial gate)	525 acre-feet
c. Active Storage (at spillway crest)	410 acre-feet
d. Maximum Surcharge (top of radial gate to dam crest)	165 acre-feet

5. Hydrology

a. Inflow Design Flood	PMF 23,100 cfs, 4,400 acre-feet
b. 100-Year Return Period	500 cfs

6. Embankment (Dam)

a. Type	Rolled earthfill
b. Hydraulic Height	50 feet
c. Crest Length	325 feet
d. Crest Width	15 feet
e. Upstream Slope	1(v) on 2.25(h)
f. Downstream Slope	1(v) on 2(h) upper 1(v) on 4(h) lower

8. Outlet Works

a. Size	48 inch diameter RCP
b. Control	48 inch diameter slide gate with control located on dam crest
c. Control Tower	Single cell wet tower
d. Length	196 feet
e. Discharge Capacity (pool at dam crest)	410 cfs

8. Spillway

a. Location	Right abutment
b. Type	Chute with 4.3 foot high radial gate, radius 5 feet, corrugated metal supported by steel frame
c. Width	20 feet
d. Length	120 feet
e. Height	10 feet
f. Capacity (pool at dam crest)	
Radial Gate Open	1,900 cfs
Radial Gate Closed	860 cfs

OPERATING PROCEDURES

The Fred Burr Water Users Association manages and operates the Fred Burr Reservoir to provide an adequate supply of irrigation water to meet contracts with water users without exceeding safe storage or flow levels, and to insure safe operation of the project.

METHOD AND SCHEDULE OF OPERATION

The association's goal is to have the reservoir full before contract holders start putting in calls for water. The normal full reservoir elevation is 5,143.3 feet with 525 acre-feet of active storage.

The date of irrigation releases begin varies from year to year, with May 1 being the earliest. Irrigation releases usually end by September 30, as specified in the water purchase contracts. The actual dates that releases begin and end depend on the year's climatological and hydrological conditions.

Water is also released from the reservoir to help regulate instream flows. These releases depend on the yearly flow conditions in Fred Burr Creek.

Winter Storage: During the fall and winter months (after the irrigation season), the outlet gate is to remain open with the reservoir elevation at 5,112 feet and 0 acre-feet of storage. This prevents the reservoir from filling and spilling during the winter months and possibly damaging the spillway radial gate, maintains flow in Fred Burr Creek, and minimizes water quality problems.

SAFE DRAWDOWN

Because the stability of Fred Burr Reservoir Dam has not been thoroughly investigated, the SWPB recommends that draw down rate not exceed one foot per day.

LIMITATIONS OF APPURTENANCES

Appurtenances at Fred Burr Reservoir Dam include the outlet works and tunnel, and spillway. With the reservoir pool at the dam crest, the maximum design capacity of the spillway with the radial gate open is 1,900 cfs. With the radial gate closed the flow is 860 cfs. A rating curve and table for the spillway is shown in Appendix A.

With the reservoir at the dam crest, the maximum capacity of the outlet conduit is 410 cfs.

The combined maximum design conveyance capacity of Fred Burr Reservoir Dam is about 2,310 cfs.

The maximum opening for the outlet gate is four feet. Openings in excess of this amount may damage the gate, gate frame, gate stem or the gate operating pedestal. The four feet of operation is measured from the top of the gate stem to the top of the gate pedestal.

DAM OPERATOR

The responsibility for the daily operation of the dam and reservoir rests with the association and it's dam operator. The dam operator is generally authorized to operate the reservoir to meet the association's goal of providing an adequate supply of irrigation water to meet water user's contracts without exceeding

safe storage and flow levels. Specific responsibilities of the dam operator are as follows:

1. Operate the mechanical features of the outlet works.
2. Coordinate the filling of the reservoir and the release of water.
3. Notify the SWPB of any unusual occurrences, such as impending floods, excessive seepage, or problems with the outlet.
4. Perform various maintenance tasks.
5. Monitor weather conditions.
6. Monitor seepage.

Typically, the out-going operator, the association, and the SWPB train a new operator. The dam operator's training focuses on the mechanical operation of the gates, measurement of the storage level, measurement of the rate of water release, daily observation of unusual conditions, and record keeping. The outlet gates are normally operated manually with a hand crank.

The outlet works are intended to be used for controlling the release of irrigation water and not for providing emergency relief.

The dam operator is normally available daily to observe the dam and perform operating functions during the times of rapid reservoir filling. During the remainder of the filling and irrigation seasons, the operator is at the dam three to five times per week. At other times, the operator visits the dam weekly or monthly. The dam operator normally does not visit the dam during the winter months due to poor access because of snow and downed trees.

Communication among the dam operator, the association, and the SWPB usually takes place by telephone. Although not routinely available, radio communication may be established during emergencies or unusual occurrences so the dam operator

can speak directly with county authorities and communicate indirectly with the SWPB staff (see Fred Burr Reservoir Dam Emergency Action Plan).

WEATHER MONITORING

The dam operator monitors weather conditions through local weather forecasts and the National Weather Service.

If severe flooding is anticipated, the NWS Missoula Office (800-676-6975 or 406-329-4712) should be contacted for information about the storm, such as the estimated storm intensity and duration, runoff duration (above base flow), and total flood volume of the storm in the Fred Burr Creek drainage.

INTERACTION WITH OTHER DAMS

Except for irrigation diversion dams, Noxon Rapids dam is the next dam downstream from Fred Burr Reservoir dam. The safety of the irrigation diversion dams and Noxon Rapids dam is not affected by the normal operation of Fred Burr Reservoir dam.

There is a small dam and reservoir (Fred Burr Lake) about seven miles upstream on Fred Burr Creek. Normal operation of this dam should have no impact on the operation of Fred Burr Reservoir dam. Therefore, interaction with other dams is not a concern during normal operations.

EMERGENCY

If it appears that the Fred Burr Reservoir dam is about to breach, or during emergency operations, the dam operator will initiate the **Fred Burr Reservoir Dam Emergency Action Plan**.

INSPECTION AND MONITORING

The SWPB inspects the dam annually. Appendix B includes an example of a SWPB inspection report form. In addition to annual inspections, SWPB personnel will inspect the dam and reservoir during and after heavy runoff, after severe rainstorms and windstorms, during high storage periods, and after an earthquake. The embankment is not monitored by instrumentation.

STRUCTURAL FEATURES INSPECTION

Structural features include the embankment, outlet works, and spillway (Figure 3). The SWPB will inspect these structures annually as part of its inspection program. Items to be checked or noted include, but are not limited to:

1. Outlet Works
   a. Any differential settlement or movement resulting in cracking of the conduit
   b. Erosion of the seals or concrete by cavitation immediately downstream of the gate
   c. Major seepage of water into the conduit
   d. Major deterioration of exposed concrete due to freeze/thaw cycles or sulfate reactions
   e. Operation of the gate through a full cycle if reservoir level allows it
   f. Free, unobstructed operation of the air vent
   g. Corrosion of any metal
   h. Proper lubrication and cleaning of the pedestal
2. Embankment
   a. Erosion gullies in dam faces
   b. Damage from burrowing animals or vegetation

c. Displacement or loss of riprap protection

d. Displacement of fill, sink holes, slumps, or other items

e. Any seepage on downstream face or base of embankment

3. Spillway
   a. Deterioration of concrete

   b. Separation or movement of joints

   c. Erosion of the spillway chute, backfill behind the walls, or stilling basin

   d. Blockage of the approach or exit channel

   e. Condition of the radial gate and cables

   f. Condition of the log boom

   g. Diversion structure above the spillway in the abutment

RIPRAP INSPECTION

The riprap along the face of the dam should be at least 30 inches thick. Immediately after the occurrence of high water, SWPB personnel will inspect the riprap and determine if additional riprap is necessary.

SEEPAGE MONITORING

Seepage had been observed along the left spillway side wall. There has been no observed sediment in the seepage water.

This seepage area is observed and monitored by the dam operator during regular visits and by the SWPB during annual inspections.

MAINTENANCE

The association is responsible for routine maintenance of the project. In addition, the SWPB may identify items that need maintenance or repair during the annual inspection.

ROUTINE MAINTENANCE

To protect the dam and keep it in good working order, the dam operator during regular visits to the dam will watch for and identify any potential maintenance requirements. As soon as a need is identified, the dam operator needs to schedule and perform the routine maintenance.

Items that may occasionally need attention include, but are not limited to:

1. *Lubrication and cleaning of gate-operating mechanisms.*
2. *Debris or silt restricting the spillway inlet or the outlet works.* Accumulated debris that could affect the operation of these appurtenances will be removed at once, with all debris removed at least annually.
3. *Erosion gullies on the embankment.* Development of erosion gullies will be checked immediately. Gullies will be filled, compacted, and seeded. Particular attention will be paid to the abutment contact areas and the downstream faces.
4. *Rodent Damage.* The rodents will be removed or destroyed, and any burrow holes should be filled immediately.
5. *Upstream slope riprap.* The upstream face riprap normally will be observed annually, but may occasionally need repairs because of high water or wave action.
6. *Vegetative cover on downstream slopes.* Good vegetative cover will be maintained, but large brush and trees will be removed.

7. *Noxious weeds.* Noxious weeds on and around the dam embankment and around the reservoir should be sprayed at least on an annual basis.

8. *Cleaning spillway and outlet structure wall tops.* Spillway and outlet structure wall tops should be clear of any dirt, rocks, grass, brush, and any overhanging vegetation or trees.

9. *Repair joints and seal cracks in the spillway and outlet structure.*

ANNUAL MAINTENANCE

The SWPB conducts annual inspections of the Fred Burr Reservoir dam and reservoir. During these inspections, any items requiring annual maintenance will be identified and recorded. Items that may need annual maintenance include the spillway, outlet works, gates, riprap, roads and gatehouse. Other routine items needing immediate attention, such as the need to remove trees or brush, will also be noted.

After the inspection, the SWPB sends the association a Dam Safety Inspection Report and a Maintenance Schedule Report. The reports identify items that need maintenance and provide a schedule of when the maintenance tasks need to be completed. The association is responsible for performing the maintenance items within the times specified.

The dam operator or association members may perform the maintenance tasks. However, major repairs will likely to be handled by a contractor. The SWPB may assist in contracting for repairs and may supervise the repair work.

RECORD KEEPING

The SWPB maintains records, including photographs, of all inspections and maintenance requirements. These records also include seepage monitoring observations. Anyone who wants to review these records may do so in the SWPB's office at the Department of Natural Resources and Conservation in Helena.

The dam operator will keep records of the reservoir elevation, seepage observations or measurements, and any unusual conditions. These records may be reviewed at the dam operator's house.

REFERENCES

CH2M Hill, June, 1980. *Phase 1 Inspection Report, National Dam Safety Program, Fred Burr Reservoir Dam, Victor, Montana, Ravalli County, MT-763.* Prepared for the State of Montana (DNRC) under the U.S. Army Corps of Engineers National Dam Safety Program.

APPENDICES

APPENDICES

APPENDIX A

RATING CURVES AND TABLES

TABLE 1. ACTIVE STORAGE IN ACRE-FEET

FRED BURR RESERVOIR

ELEV	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
5114	0	0	1	1	1	1	2	2	2	3
5115	3	3	4	4	5	5	5	6	6	7
5116	7	7	8	8	9	9	10	10	11	11
5117	12	12	13	13	14	14	15	15	16	16
5118	17	17	18	18	19	19	20	20	21	21
5119	22	23	24	25	26	27	28	29	30	31
5120	32	33	34	35	36	37	39	40	41	42
5121	43	44	45	47	48	49	50	51	52	53
5122	55	56	58	59	61	62	63	65	66	68
5123	69	70	72	73	75	76	78	79	81	82
5124	84	86	87	89	91	92	94	96	98	99
5125	101	103	104	106	108	109	111	113	115	116
5126	118	120	122	123	125	127	129	131	132	134
5127	136	138	140	142	144	146	148	150	152	154
5128	156	158	160	162	164	166	168	179	172	174
5129	176	178	180	182	184	186	188	190	192	194
5130	196	198	200	203	205	207	209	211	214	216
5131	218	220	222	225	227	229	231	233	236	238
5132	240	242	245	247	249	251	254	256	258	261
5133	263	265	268	270	272	274	277	279	281	284
5134	286	288	291	293	295	297	300	302	304	307
5135	309	311	314	316	319	321	324	326	329	331
5136	334	336	339	341	344	346	349	351	354	356
5137	359	361	364	366	369	371	374	376	379	381
5138	384	386	389	391	394	396	399	401	404	406
5139	409	412	414	417	419	422	425	427	430	432
5140	435	438	440	443	445	448	451	453	456	458
5141	461	464	466	469	472	474	477	480	483	485
5142	488	491	494	496	499	502	505	508	510	513
5143	516	519	522	525	528	531	534	537	540	543
5144	546	549	552	555	558	561	564	567	570	573
5145	576	579	582	585	588	591	594	597	600	603
5146	606	609	612	615	618	621	624	627	630	633
5147	636	639	642	645	648	651	654	657	660	663
5148	666	669	672	675	678	681	684	687	690	

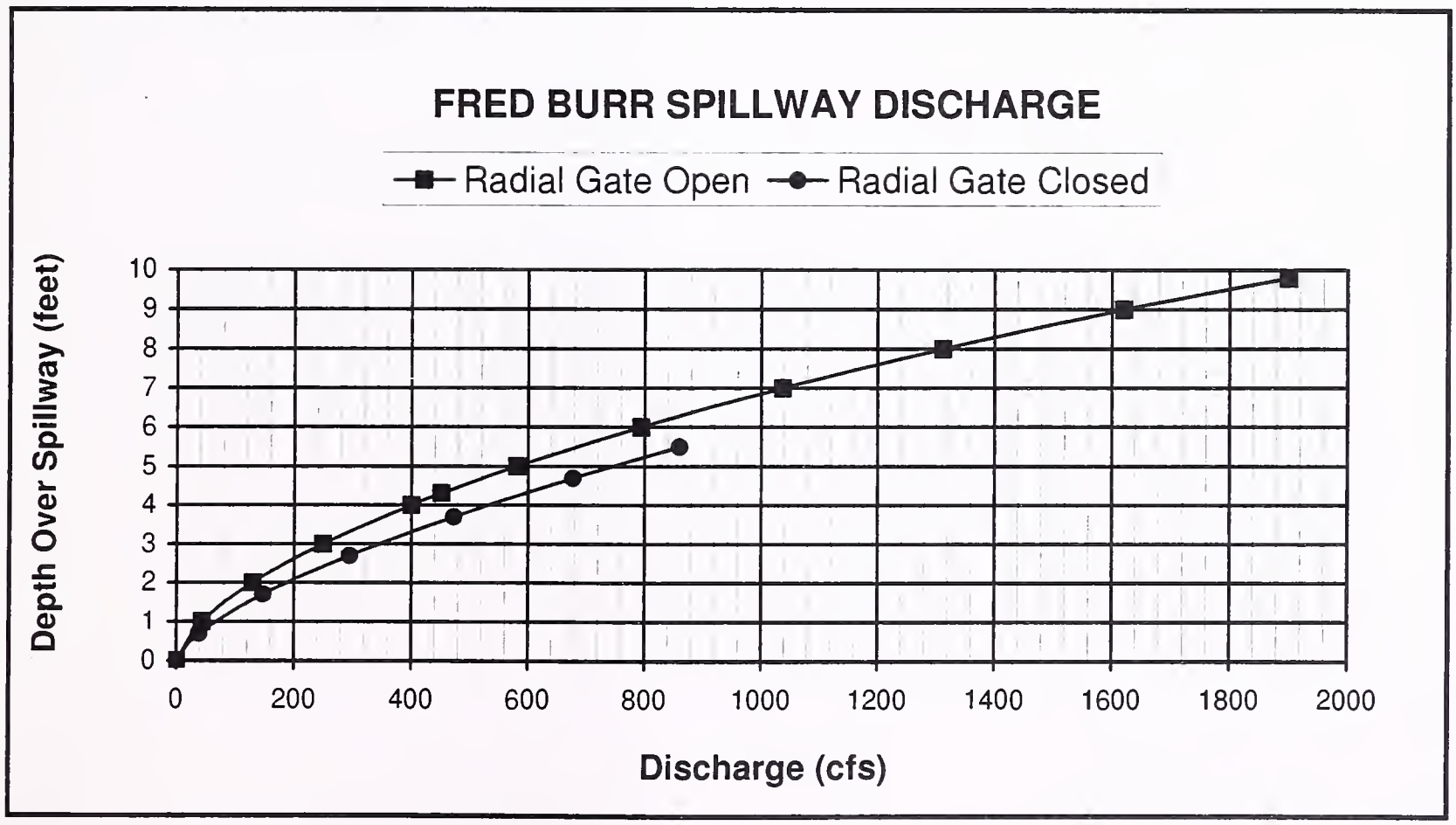
NOTE: Storage table based on 1947 original hand surveys of the reservoir.

Spillway Crest Elevation	5139.0 feet
Top of Radial Gate	5143.3 feet
Top Of Tower And Dam Crest	5148.8 feet

TABLE 2. SPILLWAY DISCHARGE

FRED BURR RESERVOIR

Elevation (feet)	Radial Gate Open		Radial Gate Closed	
	Depth Over Spillway (feet)	Discharge (cfs)	Depth Over Gate (feet)	Discharge (cfs)
5139	0	0	0	0
5140	1	44	0	0
5141	2	130	0	0
5142	3	249	0	0
5143	4	400	0	0
5143.3	4.3	451	0	0
5144	5	581	0.7	39
5145	6	794	1.7	147
5146	7	1037	2.7	295
5147	8	1312	3.7	473
5148	9	1620	4.7	677
5148.8	9.8	1900	5.5	860



Note: Data from the Corps of Engineers Phase 1 Inspection Report (1980).

APPENDIX B

INSPECTION REPORT FORM

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
DAM SAFETY INSPECTION REPORT

NAME OF DAM _____
DATE INSPECTED_____

INVENTORY NO. _____
HAZARD CATEGORY _____
TYPE OF DAM _____
YEAR BUILT _____

OWNER _____
OPERATOR _____
STREAM _____
DRAINAGE AREA _____

Reservoir Storage Status

	Water Surface Elevation (feet)	Storage (acre-feet)
At time of inspection	_____	_____
At spillway crest	_____	_____
At min. dam crest elevation	_____	_____

ITEM	YES	NO	REMARKS
1. EMBANKMENT			
A. Crest -- Height= Length= Width=			
(1) Any visual settlements?			
(2) Any misalignments?			
(3) Any cracking?			
(4) Any traffic damage?			
(5) Other?			

ITEM	YES	NO	REMARKS

1. **EMBANKMENT** (continued)

B. Upstream Face -- Slope=

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Is riprap protection adequate?			
(5) Any stone deterioration?			
(6) Any visual settlement, slumps, sloughing, depressions or bulges?			
(7) Adequate grass cover?			
(8) Debris on the dam face?			
(9) Other?			

C. Downstream Face--Slope=

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Any visual settlement, slumps, sloughing, depressions or bulges?			
(5) Is the toe drain dry?			
(6) Are the relief wells flowing?			
(7) Any boils at the toe?			
(8) Any seepage areas?			
(9) Any traffic or animal damage?			
(10) Any burrowing animals?			
(11) Adequate grass cover?			
(12) Other?			

D. Amount and Type of Vegetation on the Dam

.

ITEM	YES	NO	REMARKS

2. ABUTMENT CONTACTS

A) Any erosion?			
B) Any visual differential movement?			
C) Any cracks?			
D) Any seepage present?			
E) Other?			

3. OUTLET WORKS

A. Intake Structure -- Size=

(1) Any settlement?			
(2) Any tilting?			
(3) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(4) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(5) Metal appurtenances:			
a. Any corrosion present?			
b. Any breakage present?			
(6) Trash rack?			
a. Condition?			
b. Anchor system secure?			
(7) Other?			

ITEM	YES	NO	REMARKS

3. OUTLET WORKS (continued)

B. Conduit -- Type = Size =

(1) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Is the conduit metal?			
a. Any corrosion present?			
b. Protective coatings adequate?			
(4) Is the conduit misaligned?			
(5) Any calcium deposits?			
(6) Other?			

C. Gates and Tower

(1) Gates:			
a. Size: Operating: Emergency: b. Type: Operating: Emergency:			
(2) Controls operational?			
(3) Controls lubricated?			
(4) Operational problems?			
(5) Leakage around gates?			
(6) Condition of gate seals?			
(7) Any cavitation damage? If so, describe?			
(8) Describe air vent-size and condition.			

ITEM	YES	NO	REMARKS

3. OUTLET WORKS (continued)

C. Gates and Tower (continued)

(9) Is there a jet pump?			
a. Is it operational?			
b. Leakage?			
(10) Is the tower dry? _____ wet? __			
(11) Any seepage in the tower?			
(12) Condition of the tower?			
(13) Any safety problems?			
(14) Ladder in good condition?			
(15) Condition of the gatehouse?			
(16) Emergency plan completed for the dam?			
a. Posted in the gatehouse?			
(17) Other?			

D. Stilling Basin

(1) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Do energy dissipaters show:			
a. Signs of deterioration?			
b. Are they covered with debris?			
(4) Other?			

ITEM	YES	NO	REMARKS

3. OUTLET WORKS (continued)

E. Downstream Channel

(1) Is the channel:			
a. Eroding or backcutting?			
b. Sloughing?			
c. Obstructed?			
(2) Is released water:			
a. Undercutting the outlet?			
b. Eroding the embankment?			
(3) Other?			

4. SPILLWAY

A. Description

(1) Location?			
(2) Type of Spillway?			
(3) Size of Spillway?			
(4) Spillway lining?			
(5) Is there a weir?			
(6) Is the spillway in good condition?			
(7) Any drains?			
a. Describe the condition of drains.			

B. Does spillway show:

(1) Any cracking concrete?			
(2) Any spalling concrete?			
(3) Any exposed reinforcement in the concrete?			
(4) Any erosion?			

ITEM	YES	NO	REMARKS

4. SPILLWAY (continued)

4. B. Does spillway show: (continued)

(5) Any slope sloughing?			
(6) Any obstructions?			
(7) Displacement or offset joints?			
(8) Loss of joint material?			
(9) Leakage at the joints?			
(10) Other?			

C. Do the energy dissipaters show:

(1) Signs of deterioration?			
(2) Any cracking?			
(3) Any spalling?			
(4) Any exposed reinforcement?			
(5) Are they covered with debris?			
(6) Other?			

D. Has release water:

(1) Eroded the embankment?			
(2) Undercut the outlet?			
(3) Eroded the downstream channel?			
(4) Other?			

E. Emergency Spillway

(1) Is there an emergency spillway?			(If YES, describe)

ITEM	YES	NO	REMARKS

5. RESERVOIR CONTROL

A) Recent upstream development?			
B) Recent downstream development?			
C) Slides in reservoir area?			
D) Change in reservoir operation?			
E) Large impoundment upstream?			
F) Any debris in the reservoir?			
G) Other?			

6. INSTRUMENTATION

A) List type(s) of instrumentation:			
B) In good condition?			
C) Read periodically?			
D) Is data available?			
E) Include all data gathered since last report.			

7. DOWNSTREAM CONDITION

A. Downstream Land Use.

This dam was inspected by:

Additional comments and recommendations. (*Use additional pages if necessary*)

APPENDIX C

DISTRIBUTION LIST

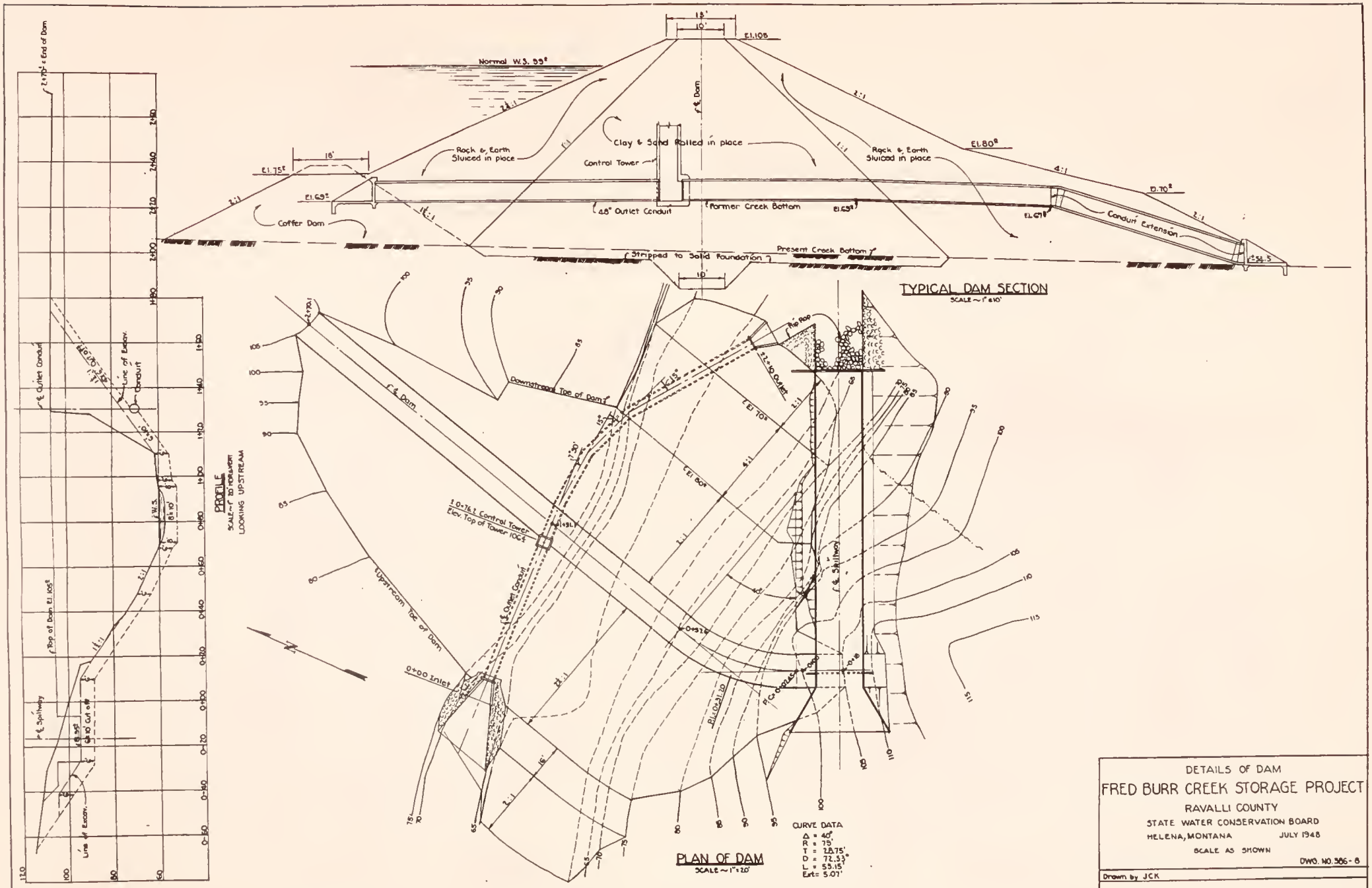
FRED BURR O&M DISTRIBUTION LIST

	Number Of Copies
1. State Water Projects Bureau Glen McDonald Greg Ames Art Taylor (2) Bob Arrington Bob Clark Delores Eustice	7
2. DNRC Information Services Section	1
3. DNRC Missoula Regional Office Bill Schultz Larry Schock	2
4. DNRC Dam Safety	1
5. Water Users Laurence Draper -- President Ed Scotti -- Vice President Linda Olbert -- Secretary/Treasurer Linley Hoselton -- Dam Operator	4
6. U.S. Forest Service Doug McClellen - Missoula Terry Anderson - Hamilton Dan Ritter - Stevensville	3
7. State Library -- Attn: Roberta Gebhardt	4
8. Extra	2
TOTAL	24

APPENDIX D

PROJECT DRAWINGS

(NOTE: These reduced project drawings are design drawings and not "As Builts". These drawing should be used for reference only. The SWPB has the full size project drawings.)



DETAILS OF DAM

FRED BURR CREEK STORAGE PROJECT

RAVALLI COUNTY

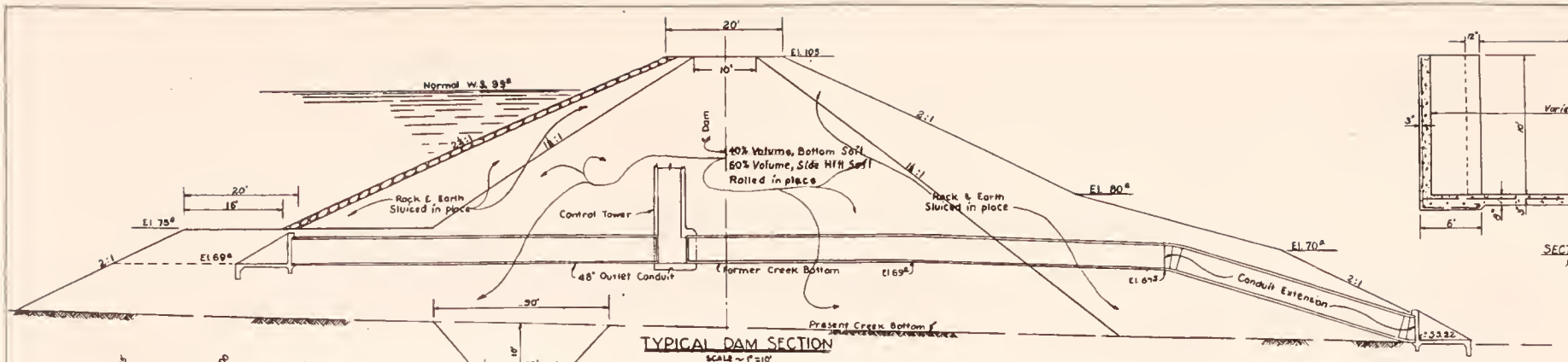
STATE WATER CONSERVATION BOARD

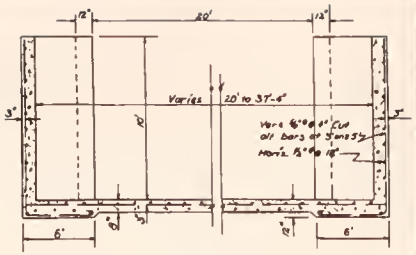
HELENA, MONTANA JULY 1948

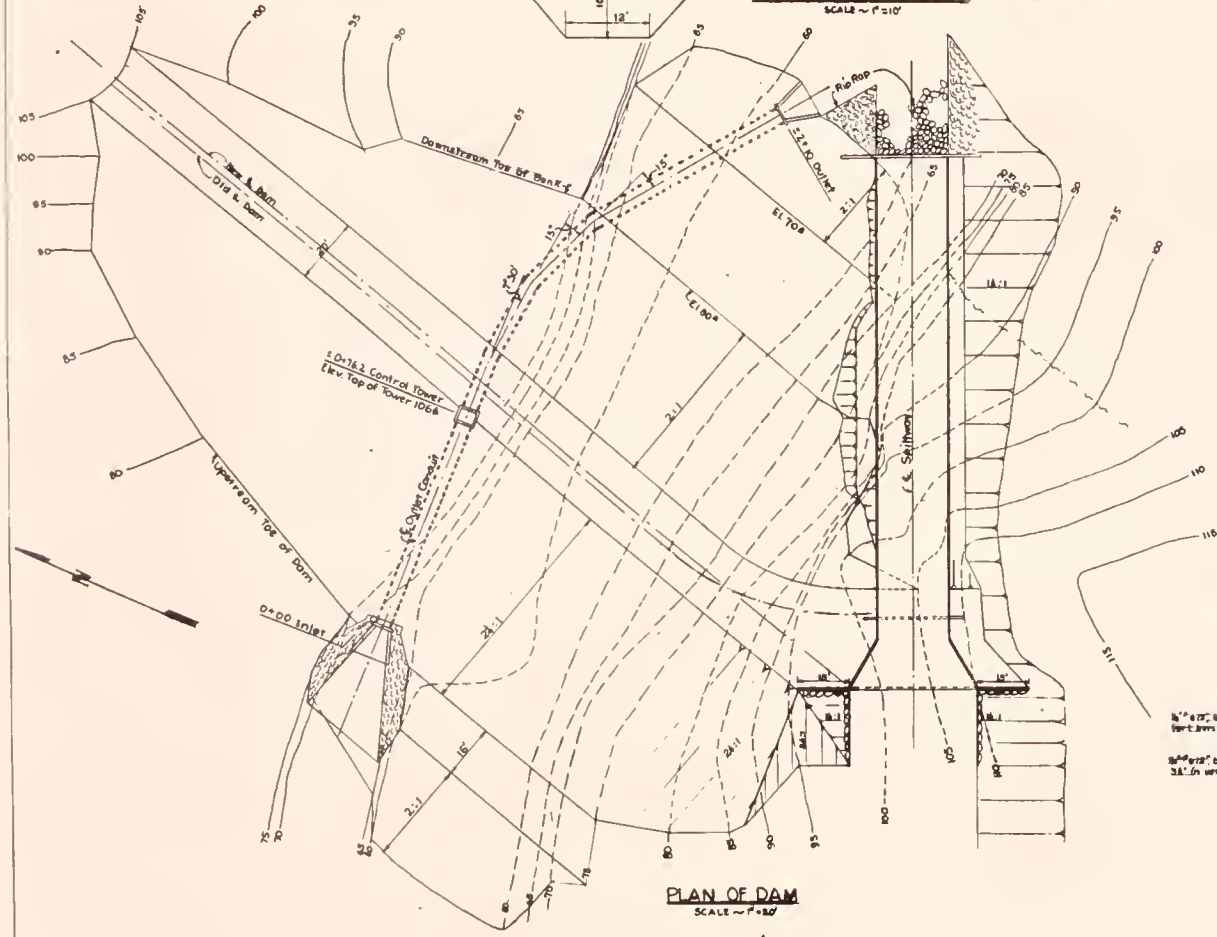
SCALE AS SHOWN

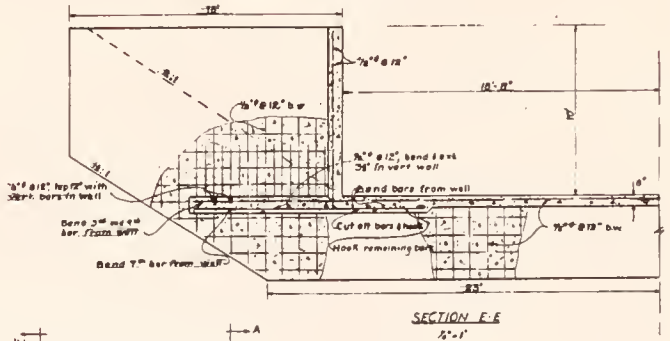
DWG. NO. 506-8

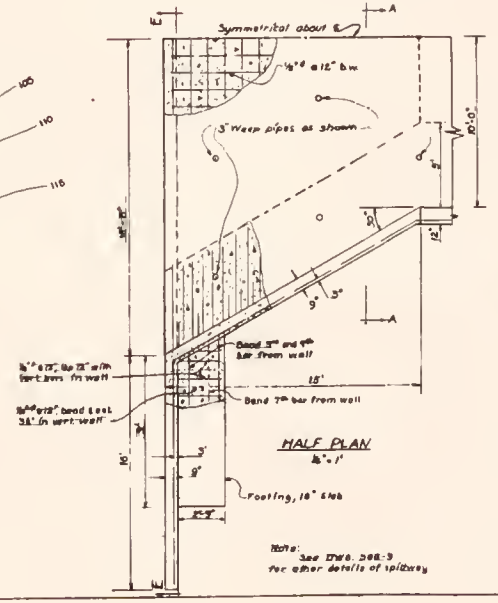
Drawn by JCK

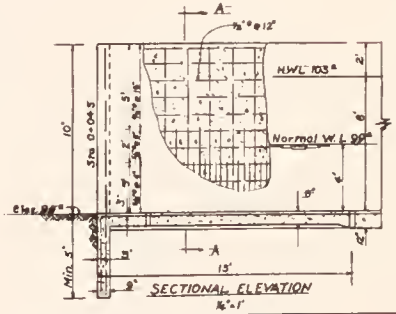




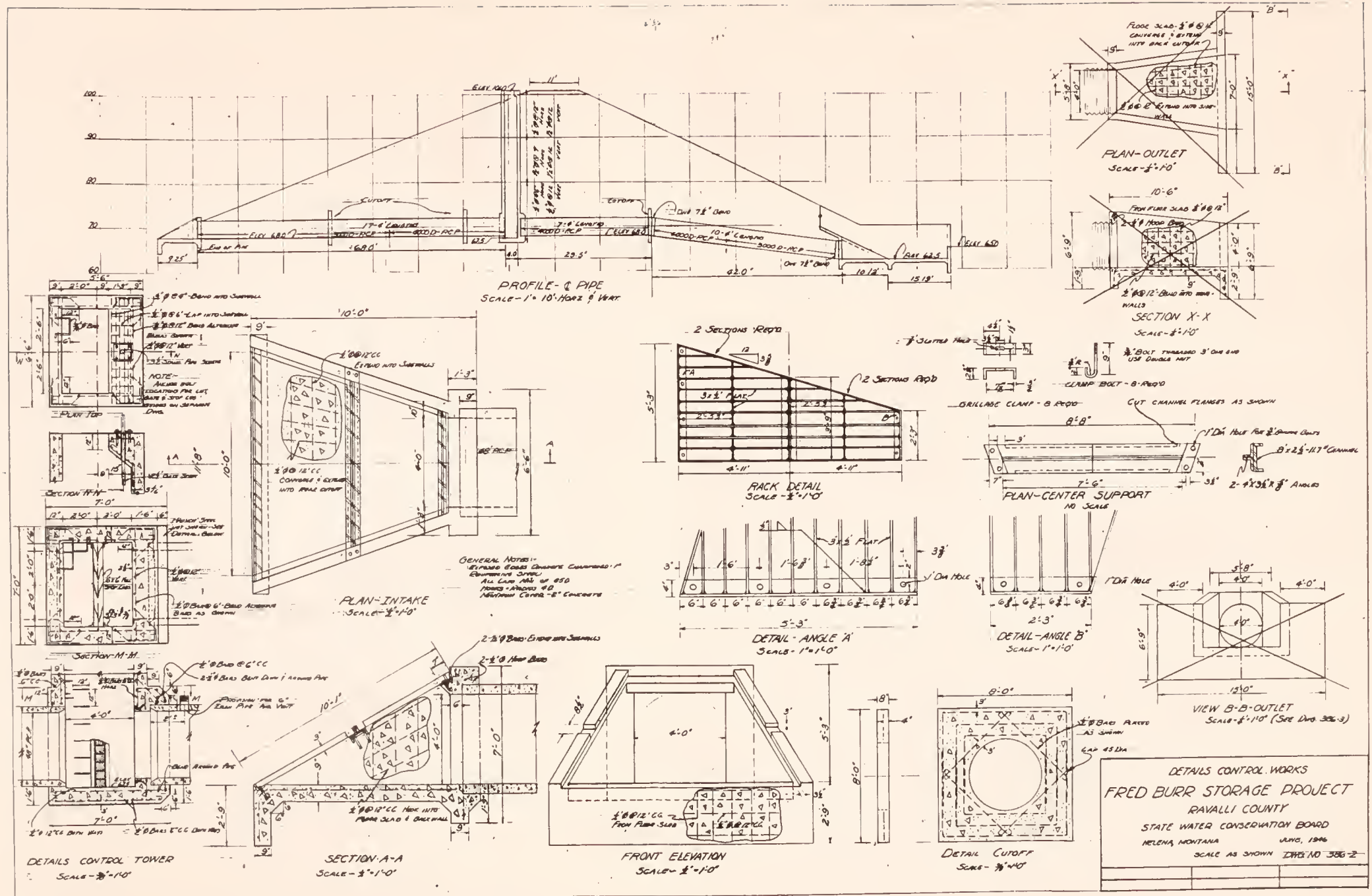


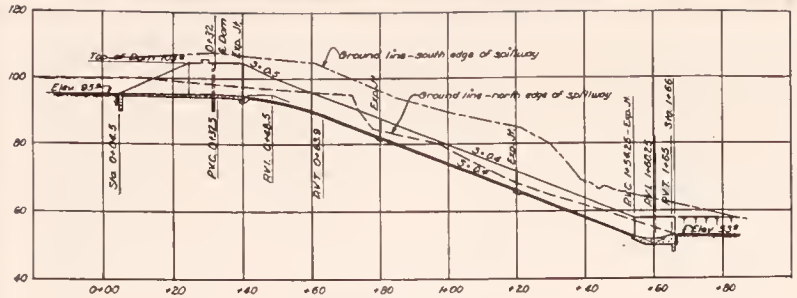

#8 @ 12" bw
#8 @ 12" bend & set 24" in vert wall
Bend bars from wall
Cut off bars & hook
Hook remaining bars
Bend 7th bar from wall
SECTION E-E
1/8" = 1'


Symmetrical about ℄
#8 @ 12" bw
3" Weep pipes as shown
Bend 3rd and 9th bar from wall
Bend 7th bar from wall
Roofing, 18" slab
HALF PLAN
1/8" = 1'
Note: See Dwg. 306-3 for other details of spillway

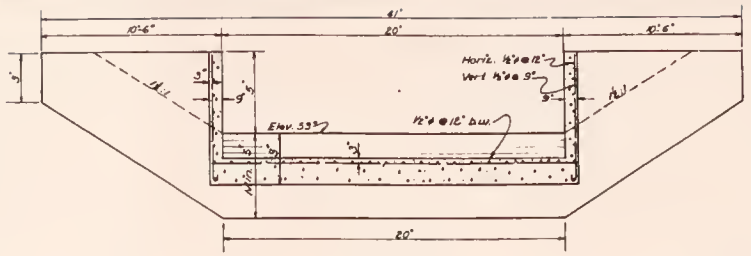


DETAILS OF DAM AND SPILLWAY
FRED BURR CREEK STORAGE PROJECT
RAVALLI COUNTY
STATE WATER CONSERVATION BOARD
HELENA, MONT. SEPT. 1948
SCALE AS SHOWN
DWG. NO. 306-8R & 8R

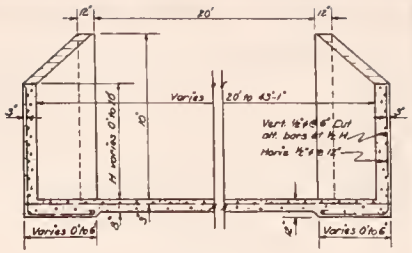

PROFILE-℄ PIPE
SCALE-1"=10' HORZ & VERT.
PLAN-OUTLET
SCALE-¼"=1'0"
SECTION X-X
SCALE-¼"=1'0"
PLAN-INTAKE
SCALE-¼"=1'0"
RACK DETAIL
SCALE-½"=1'0"
PLAN-CENTER SUPPORT
NO SCALE
DETAIL-ANGLE 'A'
SCALE-1"=1'0"
DETAIL-ANGLE 'B'
SCALE-1"=1'0"
VIEW B-B-OUTLET
SCALE-¼"=1'0" (SEE DWG 356-3)
DETAILS CONTROL TOWER
SCALE-¾"=1'0"
SECTION A-A
SCALE-¼"=1'0"
FRONT ELEVATION
SCALE-¼"=1'0"
DETAIL CUTOFF
SCALE-⅜"=1'0"
GENERAL NOTES:-
DETAILS CONTROL WORKS
FRED BURR STORAGE PROJECT
RAVALLI COUNTY
STATE WATER CONSERVATION BOARD
HELENA, MONTANA
JUNE, 1946
SCALE AS SHOWN
DWG NO 356-2



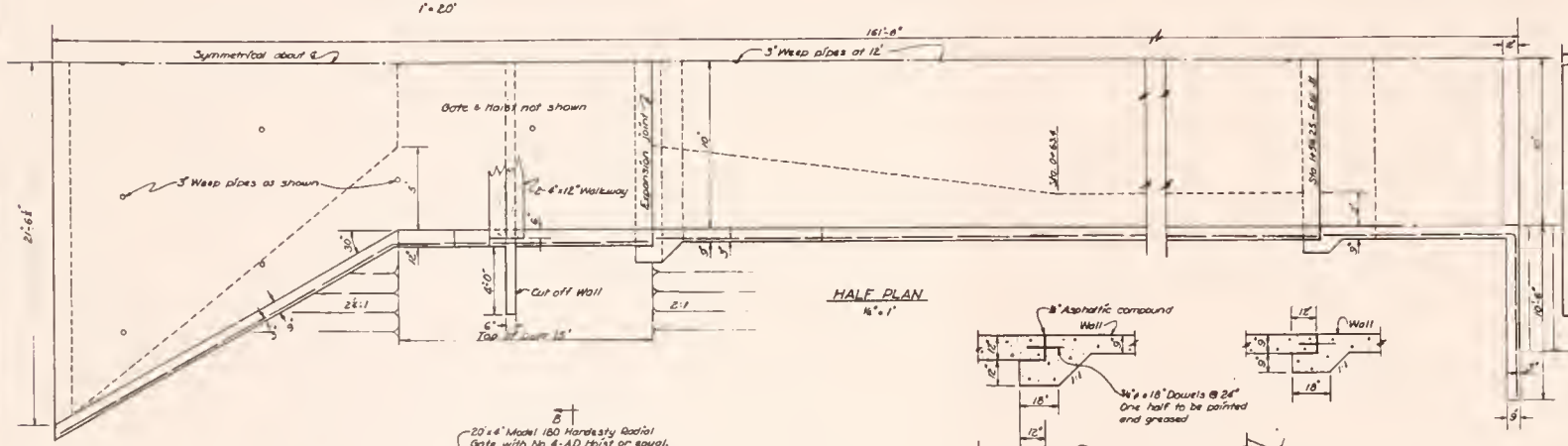
PROFILE
1" = 20'



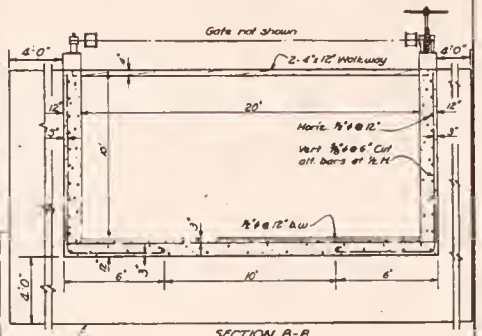
SECTION D-D
½" = 1'



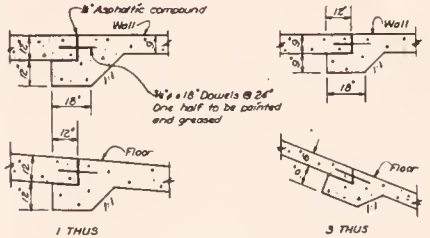
SECTION A-A
½" = 1'



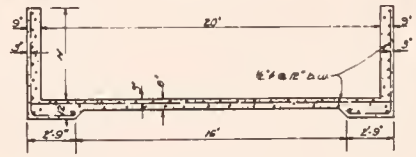
HALF PLAN
½" = 1'



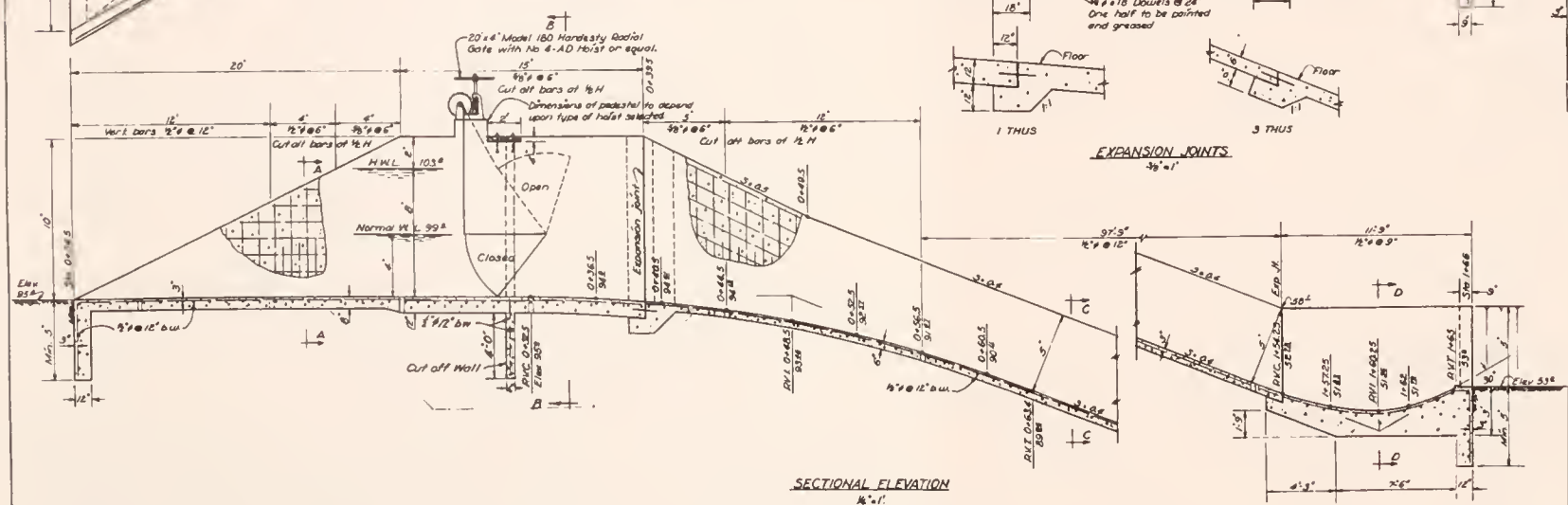
SECTION B-B
½" = 1'



EXPANSION JOINTS
½" = 1'



SECTION CC
½" = 1'



SECTIONAL ELEVATION
½" = 1'

General Notes
Min. cover of 2" of concrete over steel.
Chamfer all exposed edges of concrete 1"
Lap all bars 45 diam.; hooks to have radius of 4 bar diam. and extension of 4 bar diam

DETAILS OF SPILLWAY
FRED BURR CREEK STORAGE PROJECT
RAVALLI COUNTY
STATE WATER CONSERVATION BOARD
HELENA, MONT. JULY 1948
SCALE AS SHOWN
DWG. NO. 386-9

Drawn by JWH